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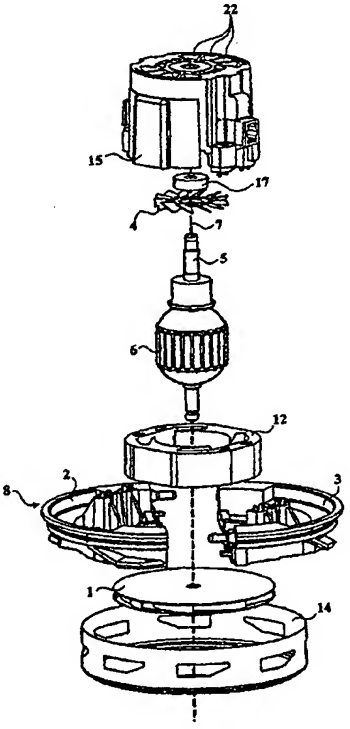
(54) Title: WET AND DRY ELECTRICAL VACUUM CLEANER MOTOR WITH REDUCED BALANCE PROBLEMS ARISING FROM ASSEMBLY



(57) Abstract: The present invention is related to a wet and dry electrical vacuum cleaner motor, wherein the air-diffuser is formed of two parts and due to this formation, it can be mounted betweem the two parts on the rotor shaft (5) afterwards; and the cooling fan (4) is placed between the commutator (13) and the roller bearing at the upper frame. Due to the position of the cooling fan and to the fact that the air diffuser is composed of two parts, motor balancing can be made at one time while the armature (6), suction fan (1) and cooling fan (4) are still mounted on the shaft and during the assembly phase of the motor, the dismantling of any of the balanced parts is not required.

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WET AND DRY ELECTRICAL VACUUM CLEANER MOTOR WITH REDUCED BALANCE PROBLEMS ARISING FROM ASSEMBLY

TECHNICAL FIELD

The present invention is related to an electrical vacuum cleaner motor and more specifically to a wet and dry type vacuum cleaner motor wherein the assembly after balancing the armature and fan assembly can be realized without requiring the dismounting of any of the balanced parts and therefore its unbalanced condition can effectively be eliminated.

BACKGROUND OF THE INVENTION

Balancing is made in order to reduce the vibrations generated during the operation of an electrical motor, and to increase the service life, or in a more general expression, it is made in order to increase the performance and the reliability of the motor.

When examined, it is seen that the most important factors having impact on the balance of the electrical vacuum cleaner motors are, the rotational speed, mass and diameter of the rotating parts. The unbalancing factors originating from the bearings and stationary parts, form the secondary impacts particularly with regard to resonance. The two main components causing unbalance are the fans (due to the size of the fan diameter) and the armature core and winding (due to its mass). Therefore, armature and fan planes comprise the planes from which removal of material is preferred during motor balancing procedure.

The wet and dry type electrical vacuum cleaner motors are high speed by-pass motors. Motor is composed of two separated parts; fan group and the motor compartment. Air sucked in by the suction fan which is positioned at the bottom, is discharged through the lateral outlet holes in order to avoid moisture from penetrating into the motor compartment. Also, a secondary air circulation is supplied by another fan (cooling fan) to cool the motor windings. Cooling fan is mounted on the upper end of the shaft. The cooling air is sucked from the inlet at the top and vented at the outlets located at the bottom periphery of the motor compartment.

The motor balancing practices employed within the present technology are not mature enough yet.

The need to have better balance levels in high speed and high efficiency electrical motors force the manufacturers to develop new balancing techniques. The approach of balancing the motor parts separately prior to the assembly is followed by the more recent motor assembly balancing approach, by which the whole motor assembly only without the fan cover is balanced. In this approach, only single plane balancing by material removal from suction fan is possible for the dry vacuum cleaner (flow-thru) motors, while in wet and dry vacuum cleaner motors, material removal from both fans is necessary for two plane balancing.

Particularly in high speed wet and dry vacuum cleaner motor, the balancing of the fans and armature together is preferred in order to obtain an effective result; however the requirement for the dismounting and re-mounting of fans after balancing due to present assembly restrictions, lead the approaches of parts balancing and motor balancing applications which in turn limit the effectiveness of balancing.

One of the parts preventing balancing armature with the fans is the air diffuser. The air diffuser being a stationary part of the motor which is of critical

importance, is used to direct the air accelerated by the suction fan towards the outlet at the periphery of the fan cover. Since the air diffuser is a stationary part that has to be mounted on the shaft between the suction fan and the armature, balancing of the armature group has to be achieved prior to the assembly of air diffuser and the fan.

In wet and dry motors the cooling fan is mounted at the other end of the shaft after the assembly of the upper frame. This sequence of assembly requires the balancing of the armature alone, otherwise disassembly and reassembly of the fan after the upper frame is necessary.

Another approach which is only applicable to dry vacuum cleaner flow-thru motors is the balancing of armature and suction fan group together in two planes. In this approach, air diffuser is made up of two parts; a sheet metal part covering the bearing housing and the complete plastic diffuser. Air diffuser is fixed on the balancing machine and material removal is achieved in two planes; suction fan and armature core.

OBJECTS OF THE INVENTION

The general object of the present invention is to increase the performance and service life of the motor, by reducing the number of the balancing steps as well as the overall time spent for balancing and at the same time to increase the balance quality and to reduce the vibrations.

One specific object of the present invention is to achieve the motor assembly of any balanced parts of the armature and fan group. Another specific object of the present invention is to minimize unbalancing impacts that may originate from assembly, by using a two-piece diffuser and to simplify the diffuser manufacturing moulds.

Yet another object of the present invention is to contribute the improvement of balancing, by moving the cooling fan to beneath the upper frame and at the same time increasing the cooling effectiveness.

BRIEF DESCRIPTION OF DRAWINGS

A preferred embodiment of the electrical vacuum cleaner motor realised to achieve these objectives of the invention is illustrated in the attached drawings as an illustrative example of the invention. In these drawings:

Figure 1- is the exploded view showing the related parts of the motor subject to the invention.

Figure 2- is a diagram showing the two-piece air diffuser

Figure 3- shows the positions of the cooling fan and the air diffuser in the armature group assembly.

Figure 4- shows the position of the cooling fan in the prior art.

Figure 5- is the section view of the cooling fan guard.

Figure 6- shows the position of the cooling fan on the rotor shaft and inside the guard

Figure 7- shows the view shown in Fig.6 with incorporated stator assembly.

Components and Terms:

1. suction fan
2. air diffuser (one piece)
3. air diffuser (other piece)
4. cooling fan
5. shaft
6. armature
7. shaft axis
8. air diffuser
9. housing

10. groove
11. upper frame
12. stator
13. commutator
14. fan cover
15. guard
16. guard
17. roller bearing
18. special locking dogs
19. pins
20. roller bearing
21. brush brackets
22. passage holes
23. roller bearing
24. volume

DESCRIPTION OF THE INVENTION

In the wet and dry electrical vacuum cleaner motor, being the subject of the present invention, the air diffuser (8) directing the air accelerated by the suction fan (1) towards the outlets at the periphery, is formed of two pieces and the cooling fan (4) is placed between the commutator (13) and the upper roller bearing (17). Due to this, the armature (6) and the fans (suction and cooling fans) can be balanced together at one time and during the assembly stage, the removal of any one of the balanced parts is not required.

The two pieces (2,3) constituting the air diffuser (8) are identical and each one forms one half of the diffuser divided along its diameter, geometrically. By joining these two pieces together and using them as one piece, the production mould is simplified, thus the cost is reduced.

As of invention, the armature group, including the both fans and the bearings, is balanced without the diffuser (8). The subassembly is balanced in two planes by material removal from the armature core and the suction fan.

After the completion of balancing, the air diffuser (8) consisting of two pieces is joined around the roller bearing (20). Thus, this construction allows us to balance the armature-fan subassembly prior to the assembly of the diffuser (Fig 3). This eliminates the need for balancing the fan and armature separately which reduces the time spent for balancing and increases the balancing quality.

Joining the diffuser pieces can be realized in various ways. For instance, opposing (mutual) projections may be formed on each piece and the pieces may be joined by using screws or pivot bolts (not shown in the drawing). Alternatively, the pieces may be interlocked after being engaged to each other by special locking dogs (18) and/or pins (19) (Fig.2).

Another example is providing around diffuser pieces with a groove (10) and holding these pieces together by means of a spring-mechanism to be clamped during assembly. Fan cover may also be utilised for this purpose. The leakage of detergent and other liquids between the joining edges should also be prevented. Furthermore, the reciprocal movements of these two pieces with regard to each other have to be prevented.

In order to compensate any mismatches of the two diffuser parts at the housing section, the housing (9) in the diffuser is designed in such a manner that a certain gap is left between the housing and the roller bearing. A special flexible adhesive material that can be applied, is used for the filling of the gap over the roller bearing (20) and thus for eliminating the tolerance errors in the bearing area. The said material is injected on the edges and on the bottom side (if required) of the housing (9).

Another significant function of this material, in addition to filling the gap, is suppressing the vibrations occurring in the armature assembly and preventing the transmitting of these vibrations to the motor enclosure. Filling the gap around the roller bearing by a flexible material, prevents the rigid/direct contact between the roller bearing and the housing which provides the isolation in terms of vibration, of the armature assembly from the motor enclosure.

Although the two-piece diffuser is essentially realised for the balancing of the wet and dry vacuum cleaner motors in more than one planes and in a single step, it can also be used for the balancing of dry type vacuum cleaner motors.

Armature plane (6) and suction fan plane (1) are preferred for proper balancing of the subassembly. As the cooling fan (4) is a far more sensitive part, its deformation for the purpose of balancing has to be prevented and it is quite important that these three parts (both fans and the armature) are balanced together for the completion of the effective balancing process in wet and dry motors at once. In other words, balancing of the armature subassembly including both fans increases the quality of the process. .

According to the prior art, the assembly of the motor cannot be realized after balancing the armature subassembly including the fans. The reason for this is the fact that the cooling fan (4) is required to be dismantled for the mounting of the upper frame (11). In other words, when the motor is balanced by the removal of the material from two planes and even if the two-piece diffuser (8) is assembled around the roller bearing (20) and connected with the stator (12), the cooling fan (4) has to be removed for the assembly of upper frame (11). This will cause the loss of the balance quality achieved again (Fig.4).

According to the present invention, the cooling fan (4) which is placed on the outer side of the upper frame (11) and mounted to the end of the shaft (5), is

mounted between the roller bearing (17) and the commutator (13). The position of the cooling fan according to the prior art is shown in Fig.-4.

The commutator, brush and windings are better cooled by the insertion of the cooling fan (4) between the upper frame (17) and the commutator. This is mainly due to avoid the screening effect of the upper frame (11) in the downstream of the cooling fan (4) which gives better cooling on the heated parts of the motor. Particularly the high temperature at the commutator (13) bars and the brush, has a negative impact on the motor service life and performance. As the result of a more effective cooling, an improvement in the motor service life and performance is expected. Especially when high speeds and powers are attained, the obtained improvement becomes more significant.

As the distance between the brush brackets (21), as well as the commutator (13) diameter has to be kept in a certain tolerance band, in this embodiment the diameter of the fan is smaller compared with a fan in an existing arrangement. Although a reduction in the air suction flow rate in connection with this is observed, since the positioning of the cooling fan (4) is closer to the parts to be cooled and the fan geometry is tuned according to the dimensions of the commutator, a better cooling effect is obtained. Whereas the smaller dimension of the fan has a positive impact on the motor balance as a whole. The cooling fan (4) diameter reduced due to the new position according to the invention, also allows the use of "plastic fan". Thus, for the manufacture of cooling fans, plastic or metallic material can be used optionally. The noise generated during air suction is reduced by the fact that the same cooling effect is attained by less air (flow-rate).

The cooling air drawn in by the motor in the vacuum cleaner, normally flows in a turbulent way. The air sucked in the motor is relaminarized as required and the flow is regulated by means of the passage holes (22) opened on the upper part of the guard (15). The fact that the wall thickness is relatively larger at the

region where the passage holes (22) are positioned, has a significant effect on this. A regulated air flow, has a positive impact on the motor performance.

By placing the fan beneath the upper frame (11), a separate cooling fan guard mounted outside the motor is no more required and the upper frame part (11) and the guard (16) are combined. This provides a decrease in the number of parts and this is an advantageous improvement both with regard to cost and to environmental impacts.

In the classical application, the reaction torque created due to the rotation of the rotor is reflected to the upper frame (11) is effected by the torsional forces created by the armature rotating in the magnetic field. According to the invention, this part is combined with the fan guard (16) and therefore the cylindrical body thus obtained is far more resistant and rigid particularly against vibrational and torsional forces.

By placing the cooling fan between the commutator (13) and roller bearing (17), the penetration of the brush dust generated during the operation of the motor, into the roller bearing is screened. As it is known, one of the factors directly having a negative impact on the service life of the roller bearings is the risk of the brush dust penetrating into the roller bearing grease.

Since the fan is mounted before the upper frame (11), it can be balanced together with the armature subassembly (4). This application significantly reduces the unbalance originating from the assembly. As a result, important improvements are obtained with regard to motor noise and vibration values.

Balancing of armature subassembly including both fans minimise the negative impacts of the assembly on balance quality. As the motor is balanced at two planes, the quality of balance is quite high. The most significant advantage of

the invention is the decrease in the number of steps to be followed during balancing operation and in the total time spent for balancing.

CLAIMS

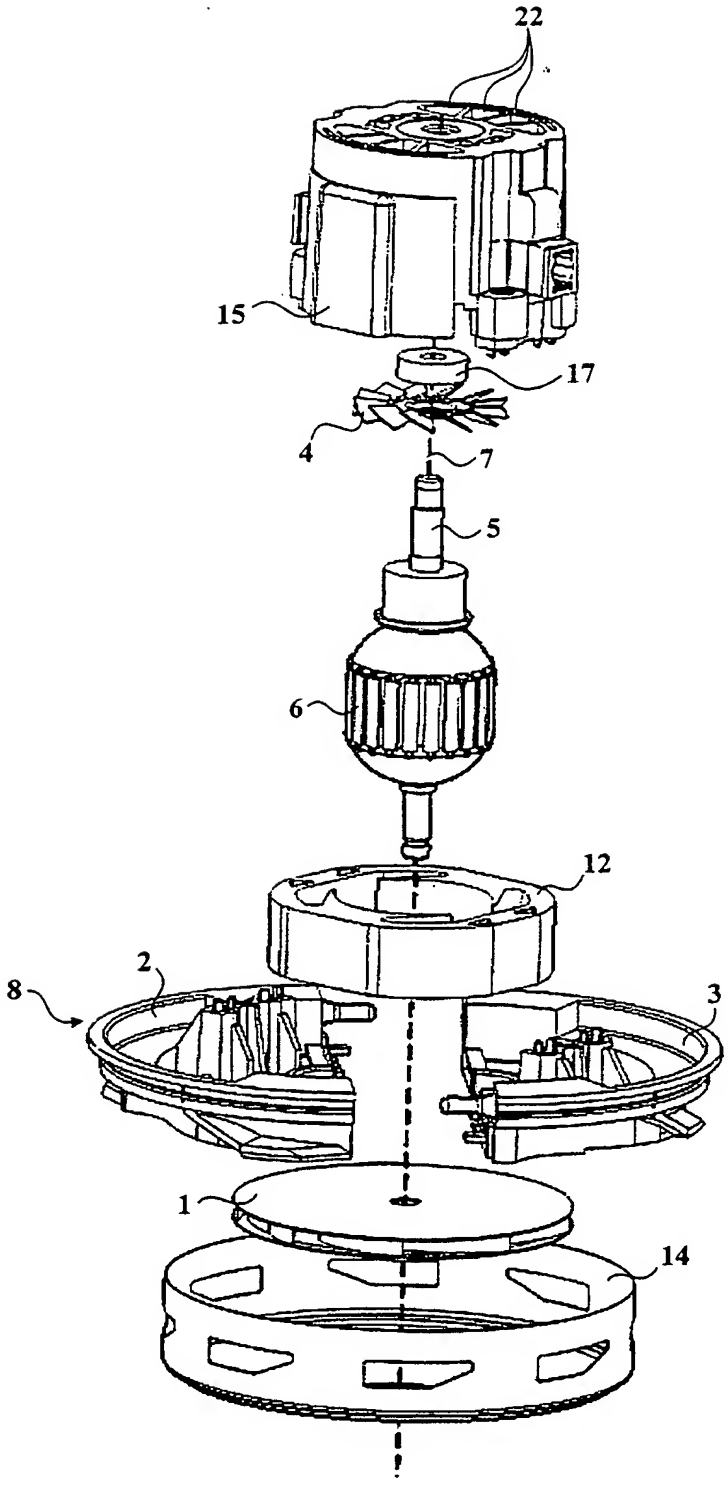
1. A wet and dry type electrical vacuum cleaner motor consisting of a cooling fan (4) enclosed by a guard (15), in addition to a suction fan; with reduced balance problems arising from assembly, characterized with an air diffuser (8) consisting of more than one pieces which can be interconnected, and which provides the assembly of the motor in its place on the shaft (5) without dismantling the suction fan (1) from the shaft (5), after balancing in one step and after being borne from two planes while only the armature (6), suction fan (1) and cooling fan (4) are assembled, during the balancing of an electrical motor used in wet and dry type electrical vacuum cleaners.

2. An electrical vacuum cleaner motor according to Claim 1, characterized in that the air diffuser (8) consists of two geometrically identical parts (2 and 3) each of which form a half formed by dividing the said diffuser in two, along its diameter.

3. An electrical vacuum cleaner motor according to Claims 1 and 2, characterized in that the cooling fan (4) is positioned between the commutator (13) and the roller bearing (17) at the upper frame.

4. An electrical vacuum cleaner motor according to Claims 1 to 3, characterized in that the said guard (15) functions both as a guard enclosing the cooling fan and as an upper frame supporting the shaft from its upper side; and contains a housing (9) to enclose the roller bearing (17) at the upper frame, two brush brackets (21) and a volume (24) large enough for the operation of the cooling fan (4) between the roller bearing (23), commutator and brush brackets (21).

Figure 1



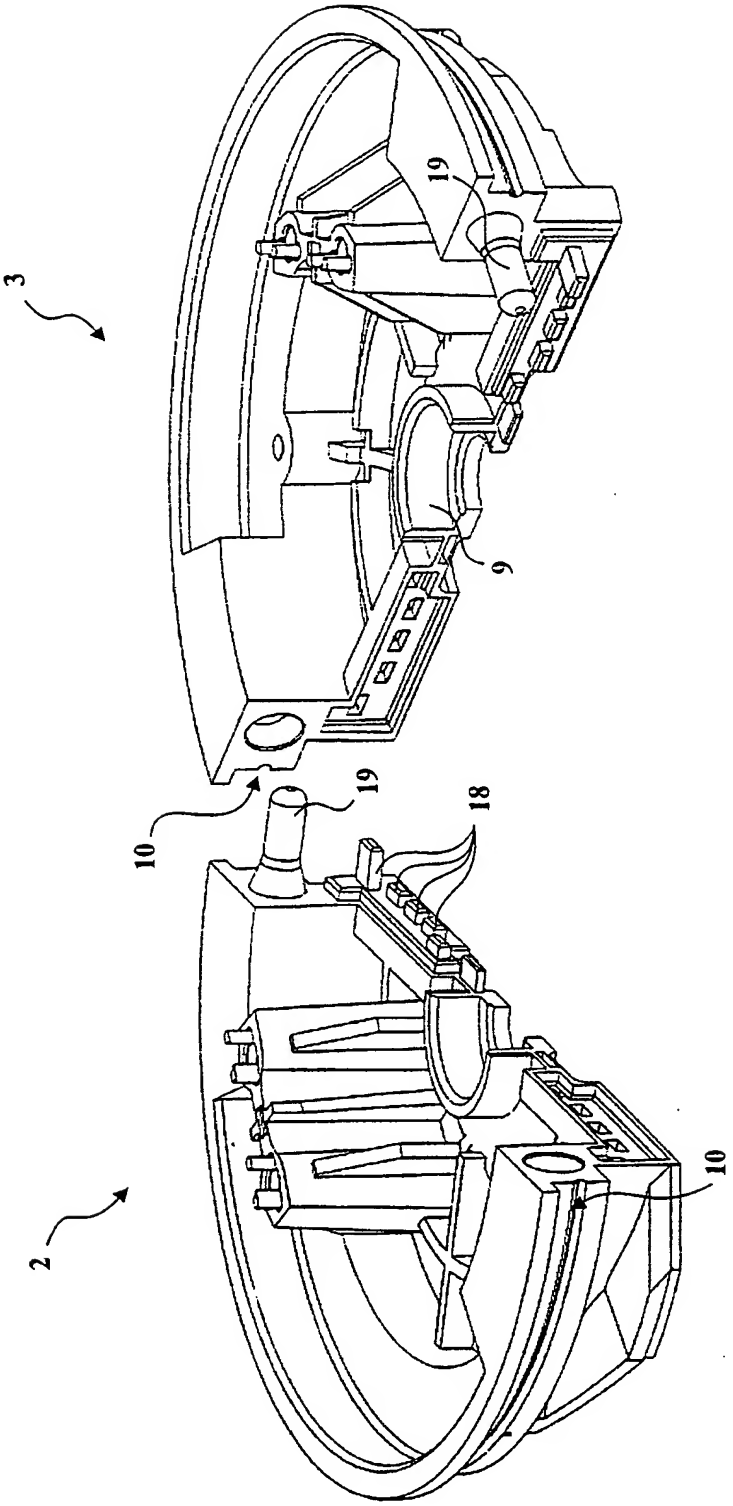


Figure 2

Figure 3

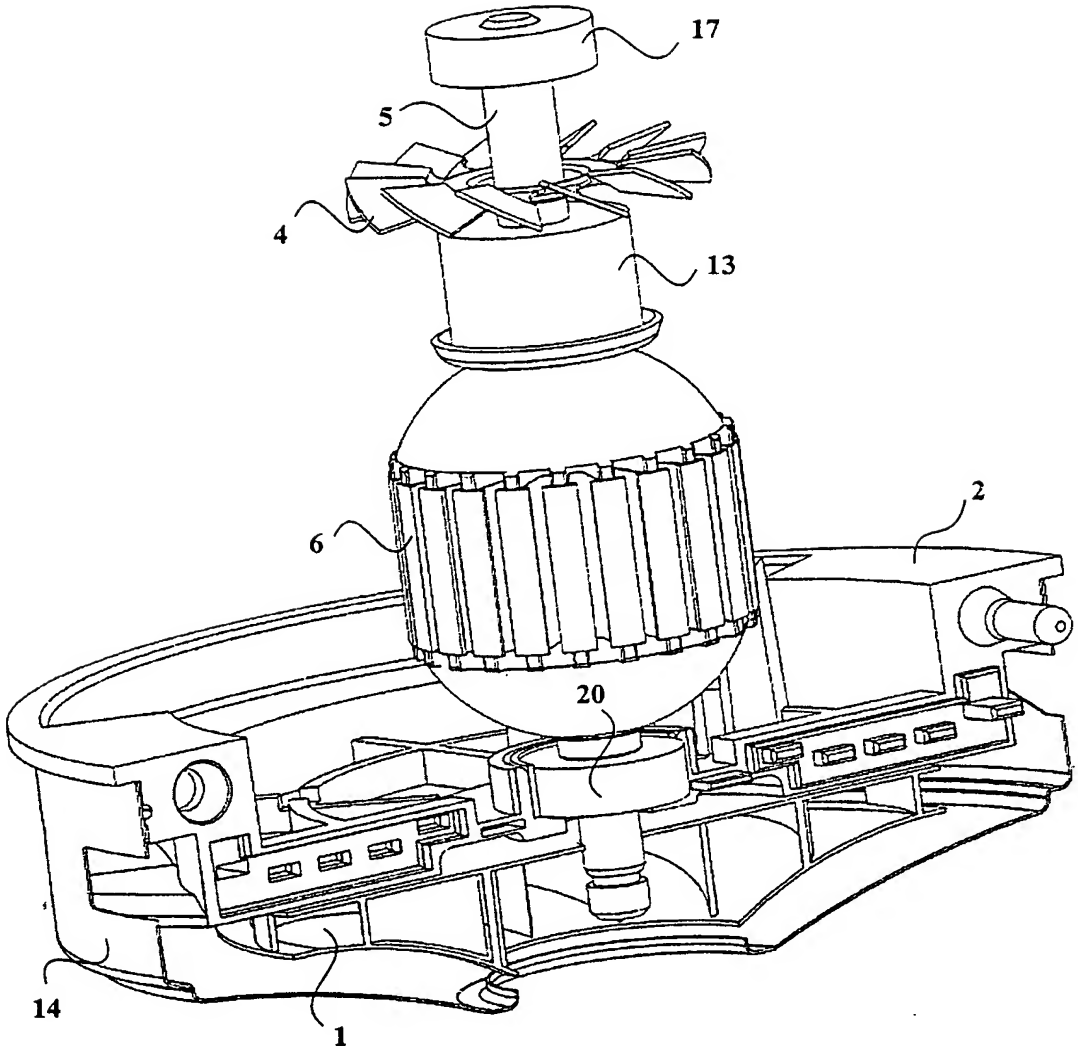


Figure 4

PRIOR ART

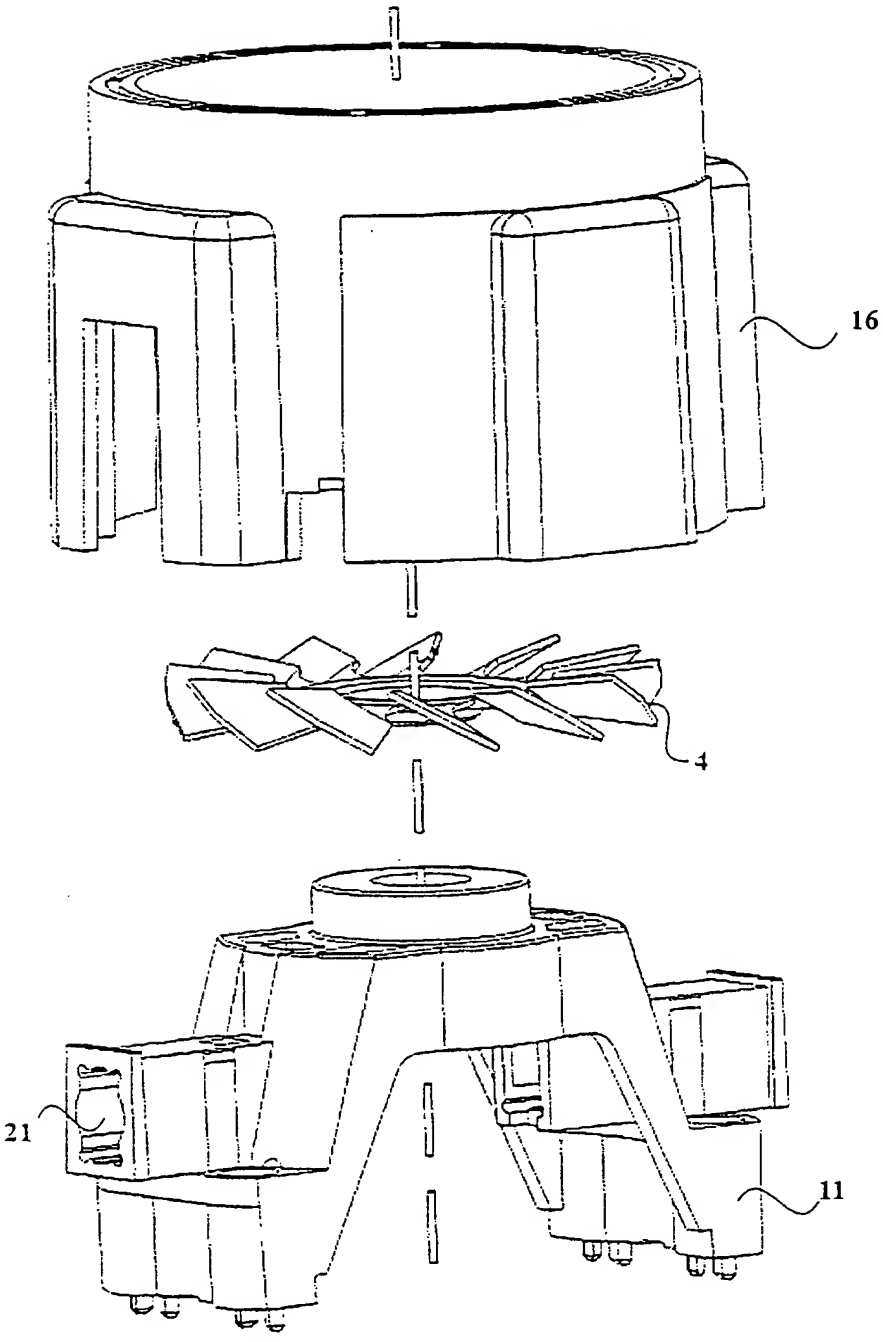


Figure 5

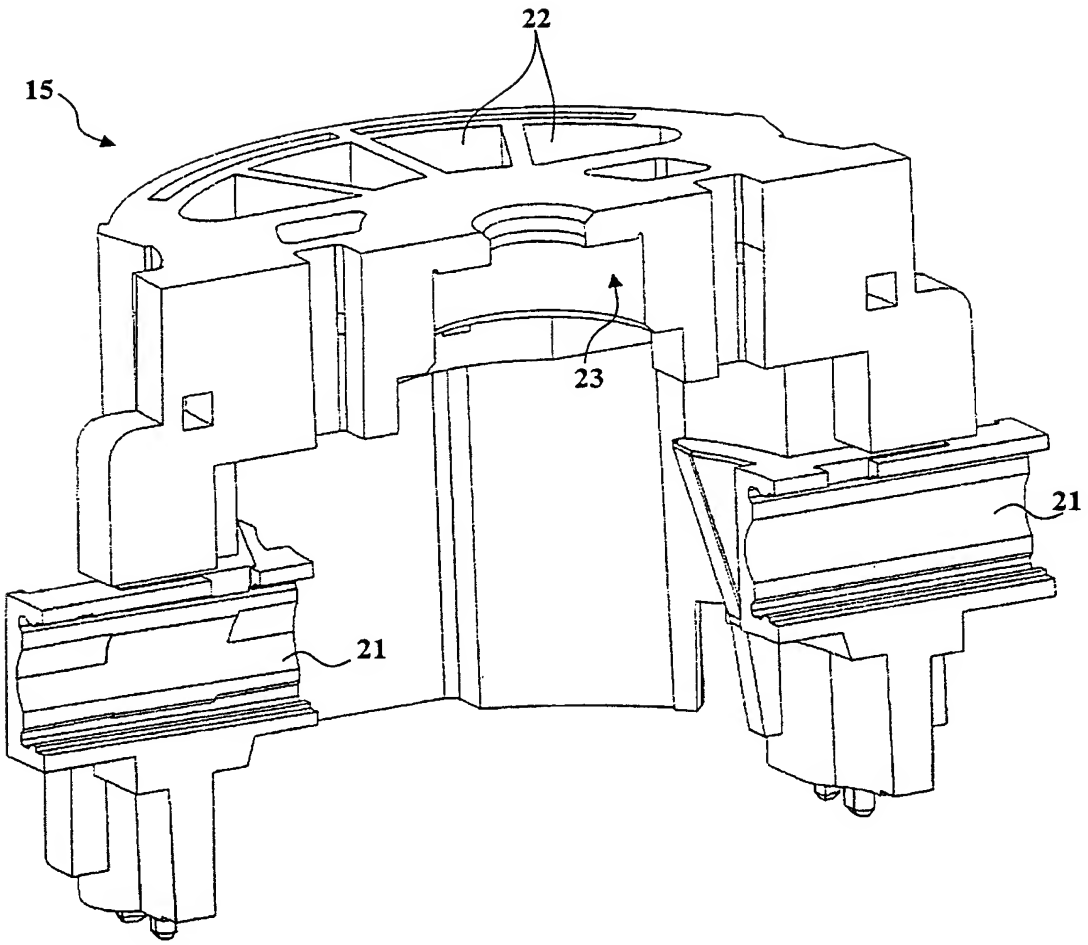


Figure 6

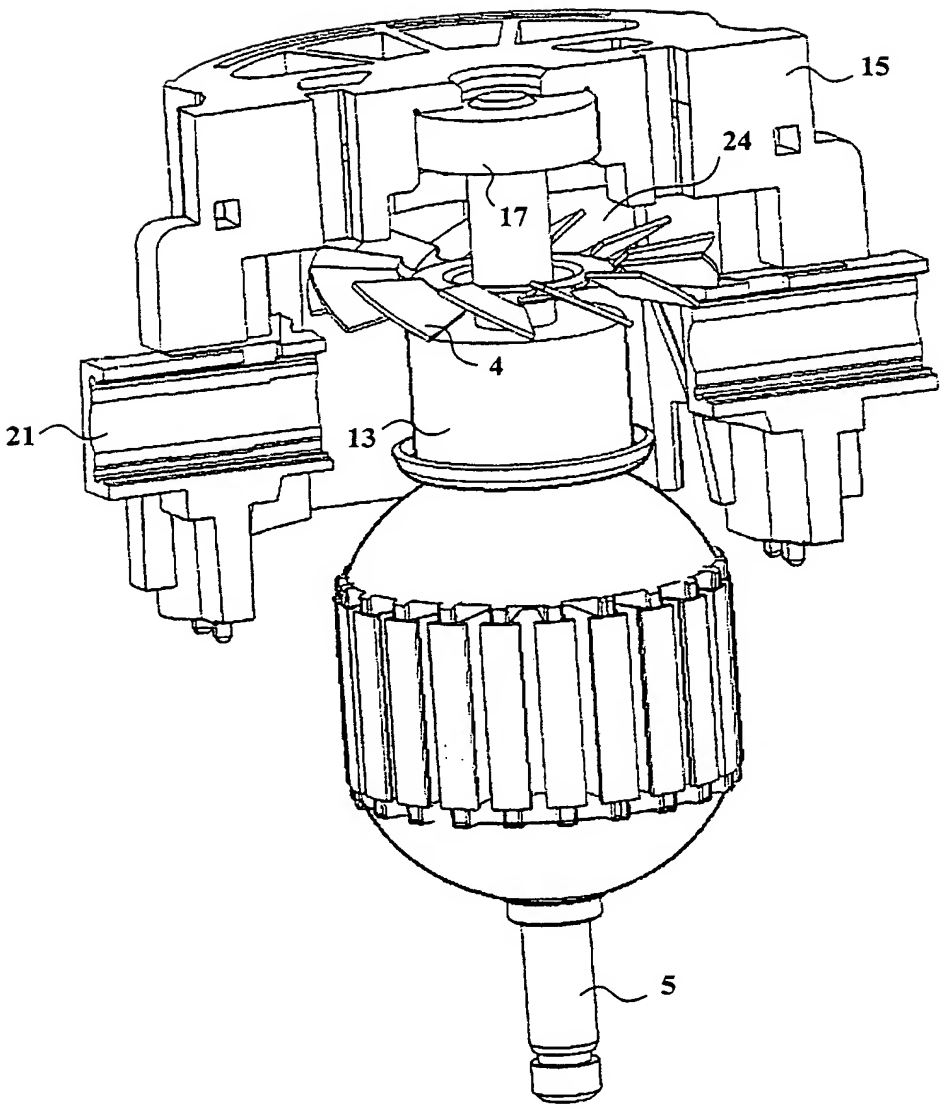
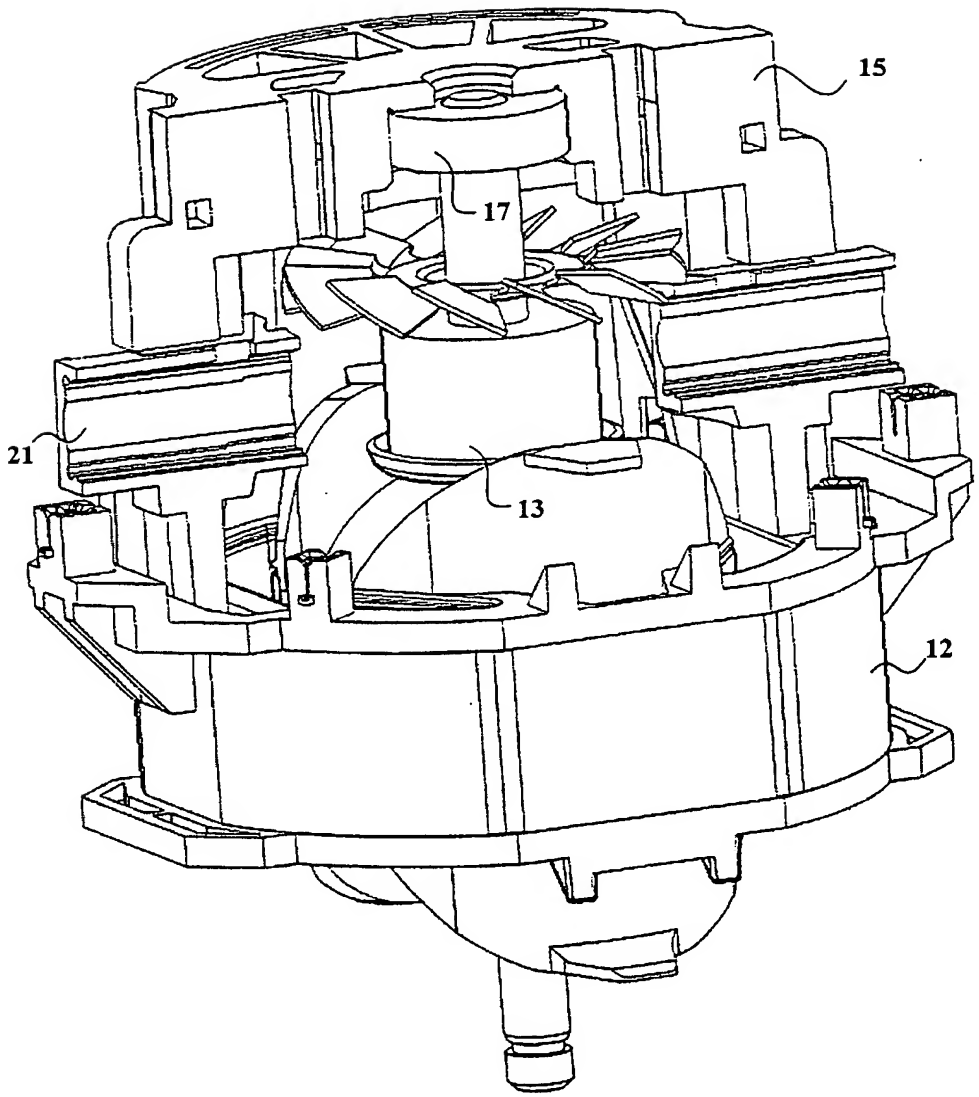


Figure 7



INTERNATIONAL SEARCH REPORT

International application No.
PCT/TR 99/00026

A. CLASSIFICATION OF SUBJECT MATTER

IPC[7]: A 47 L 9/22

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC[7]: A 47 L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0270935 A2 (SHOP-VAC CORPORATION) 15 June 1988 (15.06.88), fig. 2.	1
A	US 4783878 A1 (MC CAMBRIDGE) 15 November 1988 (15.11.88), fig. 5.	1

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
„A" document defining the general state of the art which is not considered to be of particular relevance
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Date of the actual completion of the international search	Date of mailing of the international search report
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INTERNATIONAL SEARCH REPORT

Information on patent family members

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